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PAPERS ON COCCIDÆ OR SCALE INSECTS.

THE GENUS FIORINIA IN THE
UNITED STATES.

By E. R. SASSCER,
Scientific Assistant.

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THE GENUS *FIORINIA* IN THE UNITED STATES.By E. R. SASSCER, *Scientific Assistant.*

INTRODUCTION.

The genus *Fiorinia* at the present time consists of some 30 described species and 4 varieties, and of this number there are only 2 species and 1 variety established in this country, viz, *Fiorinia fioriniæ* Targioni Tozetti, *F. theæ* Green, and *F. fioriniæ japonica* Kuwana. Judging from the available records at hand, it is quite evident that the first two coccids mentioned were imported on ornamental plants, and their status in some locations is such as to warrant the use of remedial measures. The last-named variety of *fioriniæ* is a Japanese importation, and while it appears to be established in only one State, it is not infrequently collected at quarantine on imported evergreens.

Fiorinia TARGIONI.

This genus is characterized by the adult female being smaller, decreasing in size after the second molt, and entirely inclosed in the second larval exuvia; puparium elongate, with first larval exuvia extending beyond the margin. Male scales white, elongate, with or without carinæ, larval exuvia at anterior extremity. Pygidium of adult female (*Fiorinia* s. str.), possessing well-defined median lobes, and some species exhibiting a small pair on either side; paragenitals normally in five groups, although in some species the median and anterior laterals coalesce, forming an arch.

Leonardi in his paper,¹ "Saggio de Sistematica delle Fiorionie" divides *Fiorinia* sens. lat. into three subgenera, viz, *Trulliflorinia* (paragenitals and lobes present), *Anamefiorinia* (paragenitals present, lobes absent), and *Adisconfiorinia* (paragenitals absent). *Fiorinia* s. str. is characterized by possessing paragenitals and plates, and the species discussed in this paper come distinctly within this division.

¹ Redia, vol. 3, p. 16, 1905.

The following table, based on characters exhibited by the adult female, is offered as a means for separation of the species occurring in the United States.

- I. Spatulate protuberance between antennæ present, first pair of lateral lobes represented by serrate thickenings *F. theæ* Green.
- II. Spatulate protuberance between antennæ absent, first pair of lateral lobes prominent.
 - (a) Median and anterior lateral paragenitals usually contiguous, 21-23; posterior laterals 10-16 *F. fioriniæ* Targ.
 - (b) Paragenitals massed and numerous; median 3-11, anterior laterals 16-24, posterior laterals 19-31 *F. fioriniæ* var. *japonica* Kuw.

THE TEA SCALE.

Fiorinia theæ GREEN.

PLATES X AND XI.

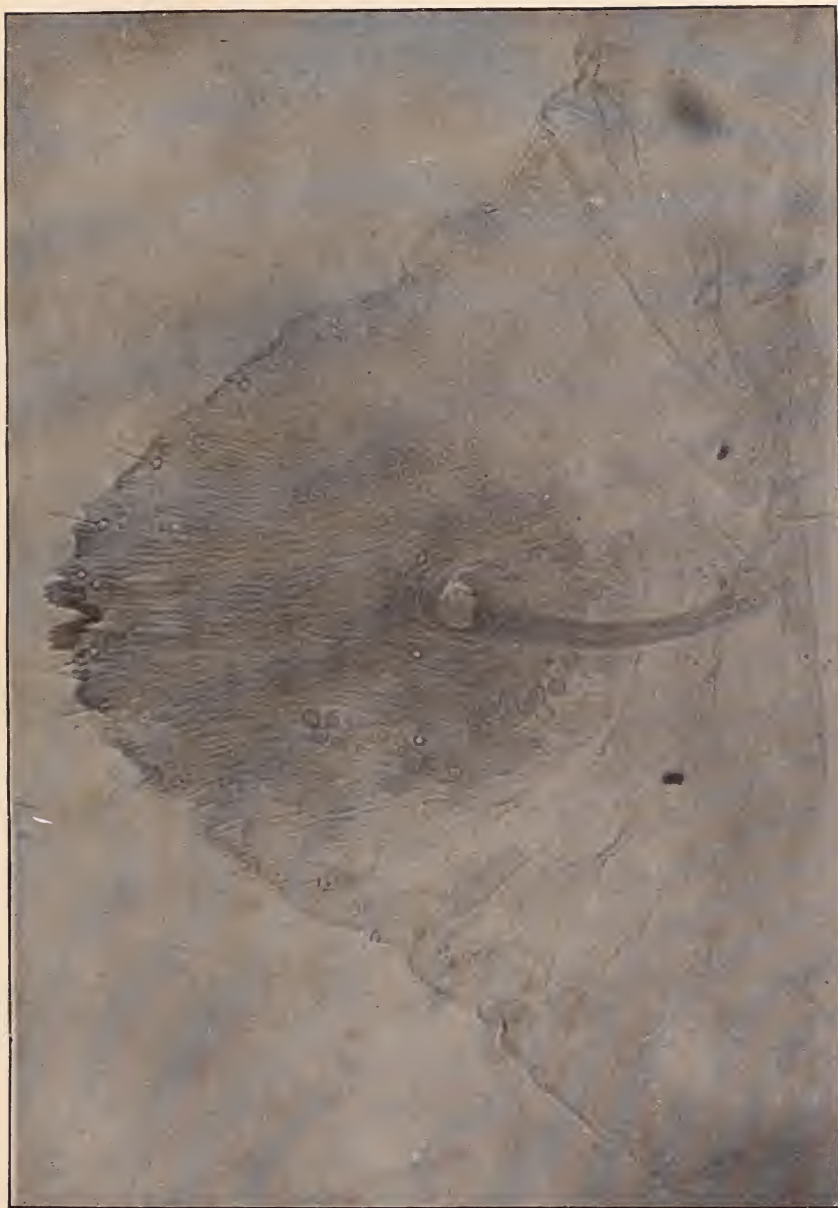
- Fiorinia fioriniæ* var. *camelliæ* Rolfe and Quaintance, Coccidæ Americanæ. Decades i-iii, No. 6 (1898).
- Fiorinia theæ* Green, Indian Museum Notes, V, No. 1, p. 3 (1900). Fig.
- Fiorinia theæ* Stebbing, Insects that affect forestry, No. 1, p. 133 (1902). Fig.
- Fiorinia theæ* Green, Indian Museum Notes, V, No. 3, p. 102 (1903). Record only.
- Fiorinia theæ* Fernald, Catalogue of the Coccidæ of the world, p. 250 (1903).
- Fiorinia theæ* Watt and Mann, The pests and blights of the tea plant, p. 306, Calcutta, 2d edition (1903). Fig.
- Fiorinia theæ* Leonardi, Redia, III, p. 28 (1905). Fig. "Saggio di Sistematica Delle Fioriniæ."
- Fiorinia theæ* Green and Mann, Memoirs of the Department of Agriculture in India, Entomological Series, I, No. 5, pp. 343, 350 (1907). Bibliography and record only.
- Fiorinia theæ* Green, Memoirs of the Department of Agriculture in India, Entomological Series, II, No. 2, p. 39 (1908). Record only.
- Fiorinia theæ* Stebbing, Manual of forest zoology for India, p. 165 (1908). Fig.
- Fiorinia theæ* Lindinger, Zeitschr. f. wiss. Insektenbiol., VII, 4, p. 127 (1911).

Notwithstanding the fact that the tea scale, *Fiorinia theæ* Green, has been in the National Collection of Coccidæ since 1887 identified as *F. fioriniæ* Targ., it was not described until 1900 by Green on tea from Assam and Kangra, India. A thorough study of the material in this collection revealed the fact that all the specimens on *Camellia*, with the exception of Comstock's type of *F. camelliæ*, which is now recognized as a synonym of *F. fioriniæ* Targ., are the tea scale of Green.

In 1897 Cockerell¹ recorded what he considered a distinct variety of *F. fioriniæ* Targ. on the underside of a leaf of *Camellia japonica* from Baton Rouge, La., and; judging from his partial description he surely had reference to *F. theæ* Green.

A microscopic study of the material in "Coccidæ Americanæ" (Decades i-iii, No. 6 [1898]), distributed by Rolfs and Quaintance

¹ Bul. Bot. Dept. Jamaica, n. s. 4, p. 149 (1897).



ANAL PLATE OF FIORINIA THEÆ. MAGNIFIED 580 DIAMETERS. (ORIGINAL.)



FIG. 2.—*FIORINIA THEÆ* ON *CAMELLIA* LEAF. ENLARGED FIVE TIMES. (ORIGINAL.)



FIG. 1.—*FIORINIA THEÆ* ON LEAF OF *CAMELLIA*. TWICE ENLARGED. (ORIGINAL.)

and labeled *F. fioriniæ* var. *camelliæ*, proves it to be *F. theæ* Green and not a variety.

In March, 1908, Mr. George F. Mitchell, of the Experimental Tea Farm at Summerville, S. C., submitted leaves of tea thickly infested with *Fiorinia theæ* Green and stated that it was becoming a serious enemy of this plant. At the request of Dr. R. H. True, Mr. J. G. Sanders, at that time an agent of the Bureau of Entomology, visited the tea farm and found this scale in abundance on Assam hybrid, Darjeeling, and China teas and camellias grown for ornamental purposes. Mr. Sanders observed that the Darjeeling tea which was grown in moist lowland was frequently covered with a brown fungus, which was apparently parasitic on the scale.

It is the belief of Dr. Charles U. Shepard, who is in charge of the experimental farm, that the tea affords better food than *Camellia japonica*, and he states that it is seldom if ever that the latter plant is killed by attack of this insect alone.

Since no plants have been introduced from Asiatic regions, all being grown from seed, it is extremely probable that its introduction was through the agency of the camellias, which have been for a number of years greatly in demand as ornamental plants in this country.

According to Watt and Mann¹ this scale is of common occurrence in both Assam and Kangra, and is the most prevalent of all coccids in the former Province. Mr. Stebbing² records it on the leaves of the olive, *Olea glandulifera*, in the northwestern Himalayas, frequently causing the leaves to turn yellow and drop off.

Although this insect occurs on both sides of the leaves of tea and *Camellia japonica*, it is more commonly found on the underside, and if present in sufficient numbers it can be easily detected by yellow markings plainly to be seen on the upper surface.

Fiorinia theæ Green can be readily separated from *F. fioriniæ* Targ. by the larger and darker scale, the presence of a proboscis-like projection between the antennæ which have no stout spines, and in the absence of lateral lobes on the pygidium.

Scale of female.—Elongate, narrow, dark brown in color, usually darker than *F. fioriniæ*, with a distinct dark median longitudinal carina; adult insect entirely inclosed in the hardened exuvia of the second stage, which varies from 1 to 1.24 mm. in length, and does not bear a secretory margin. Length, 1 to 1.40 mm. Breadth, 0.40 to 0.60 mm.

Scale of male.—Snow-white, sides nearly parallel, usually indistinctly tricarinate, pellicle pale yellow approaching lemon-yellow at extreme posterior tip. When present in large numbers the puparia

¹ The Pests and Blights of the Tea Plant (second edition), p. 306 (1903).

² Manual of Forest Zoology of India, p. 166 (1905).

are frequently covered with a flocculent secretion given off by the larvæ. Length, 0.80 to 1 mm.; breadth, about 0.40 mm.

Eggs: Arranged in double rows inclosed within the second larval exuvia.

*Female.*¹—"Adult female pale yellow, of normal form. Antennæ close together, on anterior margin; each antenna consisting of an irregular tubercle with a single curved bristle on one side. From between the antennæ springs a stout spatulate process which is not chitinous but of the same consistency as the surrounding parts of the body. Margin of thorax and abdomen with a series of minute spinneret ducts opening on to small conical tubercles. Pygidium (Pl. I) with a conspicuous median cleft, on the margin of which are situated the moderately large serrate median lobes. First pair of lateral lobes represented only by small serrate thickenings of the margin; second lateral lobes obsolete." [Although the lateral lobes are wanting in the adult, they are quite prominent on the second larval exuvia and are of the normal *F. florinæ* type.] "Spines normal, the dorsal series rather long; one pair springing from within the median cleft. Circumgenital glands in five groups; the median and upper lateral groups together forming an almost continuous arch. Median group with four or five orifices; upper laterals, 10 to 13; lower laterals, 15 to 18. A very few circular pores with accompanying ducts, on dorsal surface, near the margin. Length, 0.50 to 0.75 mm."

DISTRIBUTION.

The tea scale is recorded on Camellias in Alabama, District of Columbia, Florida, Georgia, Louisiana, North Carolina, and South Carolina. It has been collected in Ceylon, Philippine Islands, and India, occurring in the following localities in the latter country: Kangra Valley, Assam, Bashahr State close to Kilta in the Sutlej Valley, Calcutta, and the northwestern Himalayas.

FOOD PLANTS.

In the United States this scale has only been collected on camellias and tea, but in India it has been recorded on tea, olive (*Olea glandulifera*), and citrus. In the Philippine Islands it occurs on a species of *Caryola*, and Mr. R. S. Woglum has collected it on *Ostodes* in the Royal Botanical Gardens of Peradenyia, Ceylon. Although *P. theæ* seems to show a preference to the tea at Summerville, S. C., it appears to be quite a serious pest on the camellias in several of the more Southern States, and is not infrequently found associated with *Lepidosaphes lasianthi* Green.

¹ Owing to the accuracy of Mr. E. E. Green's description of this species it has been deemed wise to give it verbatim. (Indian Museum Notes, 5, No. 1, p. 3 (1900).)

ENEMIES.

The following predaceous beetles which have been determined by Mr. E. A. Schwarz, of the Bureau of Entomology, were found by Mr. Sanders preying on the tea scale: *Chilocorus bivulnerus* Muls., *Microweisea misella* Lec., and *Cybocephalus nigrutilus* Lec. As stated elsewhere, when on the Darjeeling tea these coccids are frequently covered by a parasitic fungus, which doubtless in a measure is effective in holding this pest in check.

Fiorinia fioriniæ TARG.

PLATES XII AND XIII.

Diaspis fioriniæ Targioni, Studii sul. Cocciniglie, p. 14 (1867).

Chermes arecæ Boisduval, Insectologie Agricole, p. 262 (1868).

Fiorinia pellucida Targioni, Catalogue, p. 42 (1868).

Fiorinia camelliæ Comstock, Rep. U. S. Dept. Agr. 1880, p. 329 (1881).

Uhleria fioriniæ Comstock, 2nd Rep. Dept. Ent. Cornell Univ., p. 111 (1883).

Fiorinia palmæ Green, Ind. Mus. Notes, IV, p. 5 (1896).

This coccid is a very cosmopolitan species and is of common occurrence on kentias in greenhouses. A complete bibliography of this species is not given, since it has been the subject of numerous papers, many of which, however, are of little value either from a scientific or economic standpoint.

DISCUSSION OF SYNONYMY.

A thorough study of the material on *Kentia belmoreana*, *Cycas revoluta*, and *Camellia* which was described by Comstock¹ as *Fiorinia camelliæ* proves this species to be none other than *Fiorinia fioriniæ* Targ. In 1896 Green² described a form known as *Fiorinia palmæ*, but he later reduced it to synonymy. Leonardi,³ in his paper entitled "Saggio di Systematica Delle Fioriniæ," reduces *Fiorinia fioriniæ* var. *minor* Maskell to synonymy, since Maskell in his meager description merely states that it was given varietal rank, owing to its small size. Assuming that the only character of separation was the size of the scale, Leonardi concluded that the difference was too inadequate to justify even varietal rank.

A study of the Maskell material revealed a number of characters which are surely of sufficient importance to allow it to remain as a good variety if not raised to specific rank. As will be seen by examining Plate IV, the median lobes in *minor* are larger and more chitinized, the marginal pores more numerous, varying from six to seven, and the general shape of the pygidium is different. The material of this variety is very scanty and is on the underside of a leaf which is

¹ Rep. U. S. Dept. Agr., 1880, p. 329 (1881).

² Indian Mus. Notes, IV, p. 5 (1896).

³ Redia, III, p. 16 (1905).

quite hairy, causing the scales to assume various shapes and possibly preventing them from reaching their normal dimensions. In size the pygidium of *Fiorinia fioriniæ* Targ. and *Fiorinia fioriniæ* var. *minor* Mask. compare very favorably.

DISTRIBUTION.

Fiorinia fioriniæ Targ. has a wide range of distribution and is known to occur in the following countries: Algiers, Australia, Barbados, Brazil, Ceylon, China, Egypt, Europe (Belgium and Spain), Jamaica, Japan, Madeira(?), Mauritius, Mexico, New South Wales, Peru, United States (Alabama, California, Colorado, District of Columbia, Hawaiian Islands, Louisiana, Maryland, and Massachusetts), West Africa, and Zanzibar.

FOOD PLANTS.

The food plants of this insect are numerous, some of the most important of which are the following:

Anthurium acaule, *Appolonias canariensis*, *Aralia*, *Areca aurea*, bamboo, bay, *Camellia*, *Celtis mauritiana*, *Chamærops humuli*, coconut palm, *Cupressus*, *Cycas circinalis*, *C. revoluta*, *Dracæna indivisa*, ferns, *Ficus elastica*, *Ficus* sp., *Garcinia* sp., *Hedera helix*, Japanese quince, *Kentia belmoreana*, *K. fosteriana*, *Larix* sp., *Leptospermum*, *Licula*, *Livistona*, *Persea gratissima*, *Phænix canariensis*, *Phænix* sp., *Phormium tenax*, *Phytelephas macrocarpa*, *Podocarpus*, *Strelitzia reginæ*, tea (*Thea japonica*).

ENEMIES.

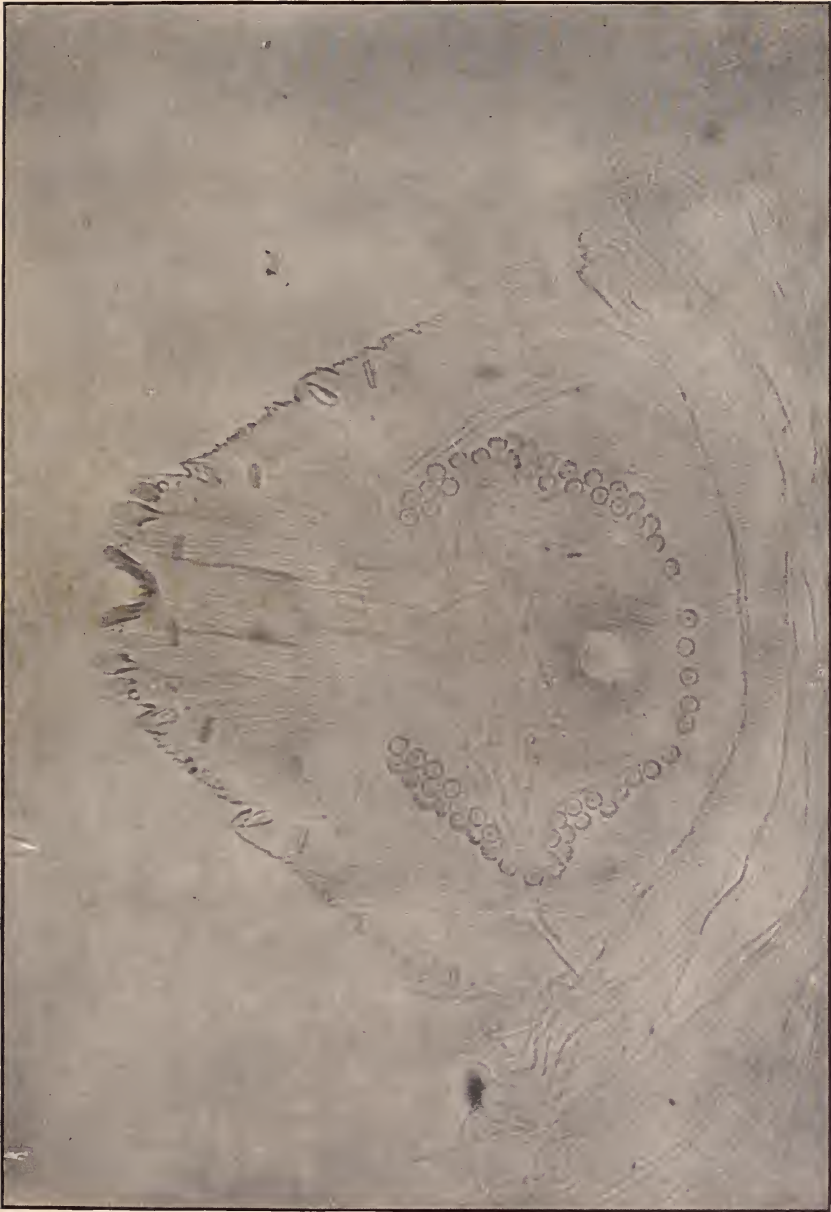
In studying the slides of the National Collection of Coccidæ one partially mature specimen of the parasite *Aspidiotiphagus citrinus* Craw was discovered inclosed in the body of an adult insect collected in Washington, D. C., on *Chæmerops humuli* and the same chalcid has also been reared from material on *Persea gratissima* from Honolulu, Hawaii. In addition to the above a species of *Aspidiotiphagus* was reared from this scale on an unknown plant collected at Hong-kong by Mr. Kœbele, and he also collected *Prospaltella aurantii* How. from this coccid on *Ficus* sp. at Swatow, Canton, China.

Among the fungous enemies of this coccid the redheaded fungus (*Sphærostilbe coccophila*) has been recorded¹ by Mr. John Parkin from Mauritius on infested *Camellia*.

DESCRIPTION.

Scale of female.—Elongate, narrow, revealing a distinct median longitudinal ridge; first larval exuvia yellow, small, and extending beyond the margin; second larval exuvia ranging from 1.20 to 1.46

¹ Ann. Roy. Bot. Gardens Peradeniya, III, p. 57 (1906).



ANAL PLATE OF FIORINIA FIORINIÆ. MAGNIFIED 608 DIAMETERS. (ORIGINAL.)



ANAL PLATE OF *FIORINIA FIORINÆ* VAR. MINOR. MAGNIFIED 515 DIAMETERS. (ORIGINAL.)

mm. in length and varying from brown to dark brown with frequently a white secretionary margin, and inclosing the adult insect, which is situated in the anterior portion of the scale. Length 1 to 1.25 mm. Breadth about 0.50 mm.

Eggs.—Yellow and arranged in a double row.

Scale of male.—White, tricarinate, larval exuvia pale yellow, Length about 1 mm. Breadth about 0.40 mm.

Female.—Thin and much contracted after oviposition, elongate, possessing rudimentary antennæ, which are apparently two-jointed, the first consisting of a fleshy tubercle, which bears the second joint and a bristle, the second joint occasionally possessing a short lateral branch near the tip; anal plate triangular, 0.187 to 0.204 mm. in width, slightly truncate at tip, median notch distinct and formed by the median lobes, which are oblique and serrated along their entire free edge; second lobes prominent both in second larval exuvia and adult, incised, about twice as long as broad and followed by several indentations; margin of the pygidium exhibiting four rather conspicuous tubular pores; between the median lobes are two short spines; located on the dorsal surface situated along the lateral margin of the median lobe there are two spines, the posterior being the larger, one on the outer lobule of the second lobe and two situated between the second lobe and the penultimate segment; on ventral surface there is a spine corresponding with each dorsal spine, except on the first lobe; laterad of each lobe there is an elongate pore and two between the second lobule and the penultimate segment; anal opening twice the width of one median lobe and far removed from the tip; median and anterior lateral paragenitals contiguous, forming an arch. 21 to 23, posterior laterals 10 to 16.

Fiorinia fioriniæ japonica Kuw.

Fiorinia fioriniæ japonica Kuwana, Proc. Cal. Acad. Sci. (3), III, p. 79 (1902).

Fiorinia fioriniæ japonica Coleman, Journ. N. Y. Ent. Soc., XI, p. 84 (1903). Record only.

Fiorinia fioriniæ japonica Leonardi, Redia, III, Fasc. 1, p. 36 (1905). Bibliography and description.

Fiorinia fioriniæ japonica Kuwana, Bul. Imp. Cent. Agr. Exp. Sta., Japan, p. 200 (1907). Bibliography and record only.

Fiorinia fioriniæ japonica Brick, Sta. f. Pflanzenschutz z. Hamburg, XI, p. 6 (1909). Record only.

Fiorinia fioriniæ japonica Brick, Jahrb. Hamb. wiss. Anst., XXVII, p. 505 (1909). Record only.

Fiorinia fioriniæ japonica Essig, Pom. Journ. Ent., II, 2, p. 207 (1910). Description and figure.

Fiorinia fioriniæ japonica Lindinger, Zeitschr. f. wiss. Insektenbiol., VII, 4, p. 126 (1911). Record only.

Although this variety of *fioriniæ* is a native of Japan, it has been introduced into this country on numerous occasions on infested ever-

greens. In September of 1908 it was collected on *Tsuga* sp., at Queens, Long Island, by Mr. F. N. Meyer, where it had apparently become established, and subsequently it was collected in New York by Mr. E. P. Felt on Japanese hemlock. In June of 1909 it was collected on the fruit and leaves of *Podocarpus elata* received by the Bureau of Plant Industry from the Botanical Gardens of New South Wales. Mr. Edward M. Ehrhorn, while horticultural commissioner of California, collected it at quarantine on *Podocarpus chinensis* and *Pinus* sp. Mr. Lindinger in a recent paper¹ records it from the Philippine Islands on *Podocarpus nageia* and *Abies veitchi* and Mr. Brick reports it from Japan on *Pinus pentaphylla*, *P. thunbergi*, and *Tsuga sieboldi*.

DESCRIPTION.

Scale of female.—Fresh female scales frequently covered with a white powdery substance, median carina indistinct and frequently not visible, brown to dark brown, reaching a chestnut brown at the anterior end of the scale; first larval exuvia yellow, about three-fourths of it extending beyond the margin; second larval exuvia 1.80 to 2 mm. in length and from 0.60 to 0.80 mm. in breadth. When collected on *Tsuga* sp., it usually occurs on the underside of the leaves, although this does not hold true in the case of the specimens on *Podocarpus*.

Scale of male.—White, apparently uncarinated, larval exuvia yellow. Length about 1 mm. Breadth about 0.40 mm.

Female.—Thin, pygidium slightly brownish, antennæ rudimentary, apparently two-jointed, the second joint bearing a spine; width of pygidium 0.187 to 0.255 mm., slightly truncate at tip, median lobes serrated along free edge, oblique forming a distinct notch, second lobes conspicuous in both second larval exuvia and adult, incised, approximately twice as long as broad, six prominent tubular pores on the margin of the pygidium with two very short spines between the median lobes; gland spines simple, long, one laterad of each lobe and one on the margin near the penultimate segment; on the dorsal surface along the lateral margin of the median lobes there are two spines, the posterior being the larger, one on the outer lobule of the second lobe, and two between second lobe and penultimate segment. Anal opening far removed from the tip and twice the width of a median lobe. Paragenitals in five groups, arranged as follows: Median group 3 to 11, anterior laterals 16 to 24, posterior laterals 19 to 31.

¹ Loc. cit.



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